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EVALUATION OF POTENTIAL ARMILLARIA ROOT DISEASE IN THE SLIDES, UPPER LAKE DISTRICT, MENDOCINO NATIONAL FOREST

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ABSTRACT

A prescription to remove competing vegetation, including oaks, from around crop trees concerns District personnel because of the potential of Armillaria root disease affecting the crop trees. Management objectives require that a certain amount of vegetation be retained on the site. Biological factors related to Armillaria root disease are discussed. Management alternatives that address the specific situation, including no action, following the prescription, and oak treatment, are presented.

INTRODUCTION

On March 28, 1984 John Dale, entomologist, and I met with Jim Harvey, silviculturist, Upper Lake Ranger District, and visited The Slides area above the Eel River. This 60-acre area supports an uneven-aged stand of Douglas-fir, ponderosa pine, sugar pine, California black oak, Pacific madrone, and canyon live oak. Trees range in size from saplings to sawtimber. The soils are highly erodible and mass movement does occur because of the type of soil and slope. Management constraints require that vegetation be maintained to ensure that soil and water quality are not reduced. Partial retention is required along a county road that transects the area. The management objective for the area is to maintain a multiple-aged stand and sufficient vegetation for maintenance of soil and water quality.

A silvicultural prescription has been prepared and some recent logging activity has occurred. The prescription allows for the designation of 60 to 70 crop trees/acre with understory vegetation within the limits of

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a diameter-plus rule being removed. This rule of thumb states that the average spacing in feet should equal the average stand diameter in inches plus a constant. Most crop trees would be of commercial size. Vegetation outside these limits will not be disturbed. Openings that already exist in the stand will not be expanded greater than 3/4-acre, if possible.

The present stand has a considerable amount of hardwoods distributed throughout. The prescription allows for their removal if they are within the prescribed distance to the crop trees. District personnel are concerned about the possibility that this could result in infection by Armillaria root disease and mortality of their crop trees. The purpose of this evaluation was to address this concern and provide management information that could minimize the future effects of this disease in this stand.

BIOLOGY OF ARMILLARIA ROOT DISEASE

Armillaria root disease is caused by the fungus Armillaria mellea. The fungus infects a wide range of hardwood and conifer hosts. Damage to conifers in California usually occurs when a fresh hardwood food base is provided from which the fungus can attack nearby conifer hosts. In most cases, infected and healthy roots must be in close proximity for transfer of the fungus to occur. Trees that are experiencing other stresses may be more prone to successful infection.

Armillaria mellea appears to be ubiquitous in the forests of California. When a tree is cut, expecially an oak, the fungus will quickly invade the declining root system. Infection success is determined partly by rapidity of fungal attack and resistance by the host. If the tree sprouts and maintains a living root system, successful infection is unlikely. If the fungus does establish itself in the root system, and there is sufficient woody mass, conifers within the root zone are susceptible to attack and subsequent mortality.

Root excavation of Armillaria-infected ponderosa pine stands in Oregon have revealed some information on underground spread of the fungus. When the fungus spreads from an infected to an uninfected root, a resinous lesion usually develops at the point of attack. From this the fungus advances distally in the dead or declining root. Rarely does it advance proximally in living roots, unless they are incapable of active host resistance. The critical region for lethal attacks on young ponderosa pines is high on the tap root or root collar. Douglas-firs in the westside of the Pacific Northwest have reduced mortality after about 30 years of age.

Various attempts have been made to evaluate the relative susceptibilities of different hosts. Several reports indicate that Douglas-fir is relatively resistant to infection. However, Armillaria root disease is a significant pest of Douglas-fir in the northern Rocky Mountain states and western Canada. Similarly, Armillaria root disease is usually considered a problem of small, younger trees. Yet in some situations it is involved in the mortality of larger, sawtimber-sized trees.

These variations have led to the development of a complex picture of this disease. Several factors appear to influence disease development and the extent of damage. These include susceptibility and age of the host, characteristics of the inoculum (food base), the strain of the fungus, and the history of harvesting operations. Research has indicated that certain strains of the fungus may be more virulent than others which may explain some variations in field observations. The interaction of these varying factors results in different effects in different situations.

MANAGEMENT ALTERNATIVES

1. No Action. If the stand is left in its present condition, then the management objectives and constraints would be met, at least for the short-term. As the stand ages the basal area and inter-tree competition would increase. The resulting stresses may cause an increase in the success of insects such as the Douglas-fir engraver, Scolytus unispinosus, in smaller trees and flat-headed borers, Buprestidae, in larger trees. Individual trees, tops, and branches would be killed by these insects. Likewise, the susceptibility of the pines would increase with respect to insect attacks. Sugar pines would be attacked by mountain pine beetles (Dendroctonus ponderosae) and ponderosa pines by western pine beetles (D. brevicomis). Both pine species would increase in susceptibility to pine engravers (Ips spp.) and California flatheaded borer (Melanophila californica). In areas of soil movement, the root disturbance may cause sufficient stress on trees resulting in successful insect attacks as was observed in the field. Older trees would become decadent with an increase in trunk decay and crown raggedness. Few additional root disease infection centers should become established.

2. Follow Prescription. Management objectives would be met and the vigor of crop trees would be maintained or increased. The increased vigor would result in reduced effects from the activities of insects. Killing large oaks in the root zone of crop trees may result in some mortality of crop trees by Armillaria root disease. The probability of infection by A. mellea would be related to the size of the oak and its proximity to the conifer. Other factors that would influence infection are less easily defined. It is not known if infection would differ with black or live oak as the food base.

3. Oak Treatment. Maintaining the health of oak root systems within the root zone of crop trees would reduce the opportunity for infection by A. mellea and possible mortality of crop trees. The larger the mass of the oak root system, the more important and effective this would be. Because of the need to limit the amount of vegetation around crop trees, discussion in the field centered around the possibility of defining a diameter limit below which oaks could be killed with little damage to crop trees occurring from Armillaria root disease. No such information is available for the California situation. What is available comes from work with eastern oaks. The latter suggests a limit of 4 inches dbh. Based on discussions and observations in the field this would not be satisfactory to sufficiently reduce the amount of competing vegetation.

For oaks larger than 4 inches dbh two options are available. One is to kill the oaks and expect some mortality of crop trees from Armillaria root disease. The amount of mortality may be small because of the size of the crop trees and the apparent resistance of this size of trees. The second option would reduce the risk of mortality from Armillaria root disease. Rather than killing the larger oaks they would be felled and allowed to sprout. In 5 to 10 years the sprouts would be thinned down to 1 to 2 per clump. This would reduce the amount of competition while maintaining the health of the oak root system. When selecting sprouts to leave, those that originate at or below the ground line will be the firmest and have the lowest incidence of later decay. Stumps should not originally be cut higher than 8 inches from the ground.

The general principles discussed above may be suitable for other areas, but the alternatives were designed to fit the management objectives and characteristics of The Slides area.